~~Proposed~~ Draft Framework to Restore Hood Canal

This is a ~~proposed~~ draft framework to guide current efforts to restore dissolved oxygen (DO) in Hood Canal. This framework identifies an overarching goal to the restoration of Hood Canal hypoxia, provides a system to track the relationship between numerous discrete grants and efforts currently underway in Hood Canal, and establishes a vision for how a strategy can be developed to improve DO levels in Hood Canal.

This document is organized into four sections: 1) identification of proposed long-term / overarching goal and short-mid term targets; 2) development of a system to track the relationships among various efforts currently underway and strategy for steps forward; 3) map of interrelationship of core components of the proposed framework; and 4) identification of key activities associated with each core component of the proposed framework.

This framework is based on the assumption that nitrogen inputs (and associated increases in primary productivity) are the primary anthropogenic stressor on DO levels in Hood Canal. The framework starts with an emphasis on resource management goals. Once these resource goals are established, water quality models can be employed to establish a causative link between nitrogen inputs and DO impacts in areas of greatest concern. Proactive pollution control activities (e.g., pilot projects) are initiated alongside the scientific assessment effort. Upon development and application of the water quality models, the full range of human influences can be identified and addressed through prioritized corrective actions.

~~Proposed~~ Draft framework:

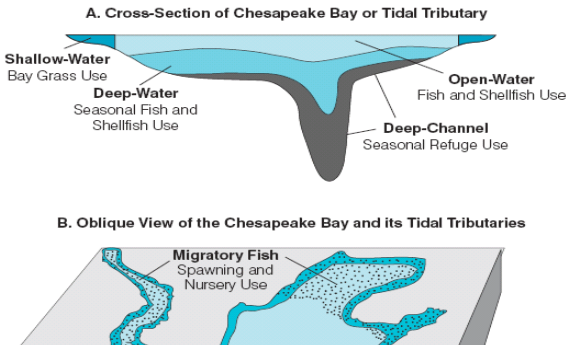
~~**Establish *tangible* resource management goals (reduced habitat impairment due to DO) linked (via model) to *directly quantifiable* (nitrogen) contributions from corrective actions.**~~

~~*Assumption: 1) Nitrogen is driver of DO problem in Hood Canal*~~

1. Identification of Proposed Goals and Targets

- **Long-term target / overarching goal**: decreased spatial and temporal impairment of identified target habitats due to DO (unique DO thresholds for each habitat identified).
    - ***Will require:***
        - Segmentation of Hood Canal into functional, distinct aquatic ecosystems
        - Identification of key sensitive and/or indicator species for each target habitat and associated DO thresholds signifying habitat impairment
        - *****Monitoring for baseline and ongoing data representative of each target habitat to asses change over time (e.g. DO, species abundance, etc.)*** (Will need to be in alignment ASAP if this is approach taken)**
        - Ability for model to assess N-DO dynamics occurring in each target habitat
        - Model to translate N reduction actions into DO improvements for each target habitat
        - Example of how Chesapeake Bay segmented its system into component target habitats:

Figure 1.



- ***Why***:
  - Aligns with Puget Sound Partnership's Ecosystem Approach
  - Places problem into more holistic context of ecosystem function
  - Ability to better engage public; loss of habitat and species are better understood by public than DO
  - Ability to translate directly to economic impact (via loss of species)
  - Direct linkage with other Puget Sound Partnership Priorities (species protection, habitat protection and restoration, water quality, human health and well-being)

- **Short, mid and long term target**: reduce annual nitrogen load into Hood Canal watershed

  - ***Why nitrogen loads?***
    - Easier means to quantify effectiveness of proposed actions
    - Common unit to measure effect of corrective actions
    - Tangible (vs. DO)
    - Negotiable

  - ***Why now?***
  - ***No water quality model to link nitrogen to DO in early stages of plan***

    - We can draw on commonly accepted givens/assumptions ~~Ability to establish initial targets despite current uncertainties~~
      - Assumptions:
        - N is key driver of DO problem.
        - Because of poor circulation and the great depth of Hood Canal, ~~despite possibility that complete control of human inputs may not allow HC to achieve DO standards.~~ human inputs will need to be kept to a minimum to achieve Washington standards for DO.
        - ~~Although marine inputs are significant, anthropogenic inputs will still have some impact on magnitude, duration and/or extent of DO impairment~~
      - ~~Uncertain anthropogenic influence~~
      - ~~Possibility DO standard may never be completely met – allows for improvement in decreased spatial and temporal DO impairment~~
      - Fine tune nitrogen targets with model outcomes ~~and national EPA nutrient criteria guidance.~~

2. Strategy / Process[1] (how the pieces fit together)

- **Strategy**: reduce impairment (spatial extent, duration, magnitude) of target habitat types due to DO threshold exceedances in Hood Canal serves as the overarching goal of all efforts. Given the assumption that nitrogen is the key cause of hypoxia in Hood Canal, the focus of the strategy to improve DO focuses largely on developing a nitrogen reduction strategy developed by engaged stakeholders and guided by model simulations.

[1] The objective of this logic model exercise is to enhance accountability of how EPA funds are spent towards improving Hood Canal's hypoxia problem. Although the focus of this logic model was initially intended to target measuring potential success achievable of 18 corrective action efforts funded (2004-5), I found that the success of these efforts depended largely on an understanding of the context within which they would serve. On their own, as individual projects, they could not achieve success in improving hypoxia in Hood Canal. Thus, this is an attempt to sketch a potential process / strategy within which the pilot efforts would play, and an attempt to identify potential long-term targets and measures of success.

- **Process**[2]: key steps toward the development of a nitrogen reduction strategy:

  - ***Data Gathering***: data to support model development, stakeholder strategy development process, baseline condition assessment and to gage effectiveness of potential solutions.

  - ~~***Scenario Simulation***~~ Water Quality Assessment: use of water quality models and other quantitative analyses to answer key questions necessary for strategy development, including –
    - Identification and verification of key sources of N input to HC
    - Quantification of total human contribution and influence on HC DO
    - Identification of high risk areas
    - Gage effectiveness of potential solutions to improving DO in each identified target habitat
    - Translate each phase of the N reduction strategy to DO improvement

  - ***Stakeholder Engagement***: Engage stakeholders to get broad concurrence on key sources (current and future) and strategy to improve DO throughout HC via reduced nitrogen loading. Strategy development can be informed by the following types of information to guide the decision-making process:
    - N input by key sources and their locations
    - Impact of N on DO by source and location
    - Impact of incremental reductions DO on biology/ecology
    - Impact of species/habitat loss to economy
    - Cost-benefit analysis: cost of incremental reduction of N associated with different levels of management and resultant improvements in DO; by source and area
    - High risk areas
    - Other additional means to reduce N input beyond source control e.g. transport mechanisms (stormwater), and/or mitigation (wetlands)

  - ***Political Commitment***: establish local and state commitment to nitrogen reduction targets on a sub-watershed basis (targets established at WRIA level?). Ideally, through use of phased approach.

  - ***Education and Outreach***: general and targeted education and outreach to communicate issues, as well as 'how-to' information (e.g. BMPs, etc.)

  - ***Implementation and Strategic Funding***: implementation of nitrogen reduction strategy and identification of strategic funding mechanisms to ensure long-term sustainability of efforts.

- **Measuring Success**

  - **Modular logic model** (***see Figure 2, attached***): bulk of components comprising this framework serve as information development to support other components. Only certain components may have short and long-term targets and measures of success (e.g. each source control effort in the implementation phase may have its own logic model; separate education and outreach efforts may also have individual logic models measuring success)

[2] Informed strongly by Rhode Island and Tampa Bay nutrient reduction strategy

Figure 2.

Draft Proposed Framework to Restore Hood Canal: Relationships of Component Efforts

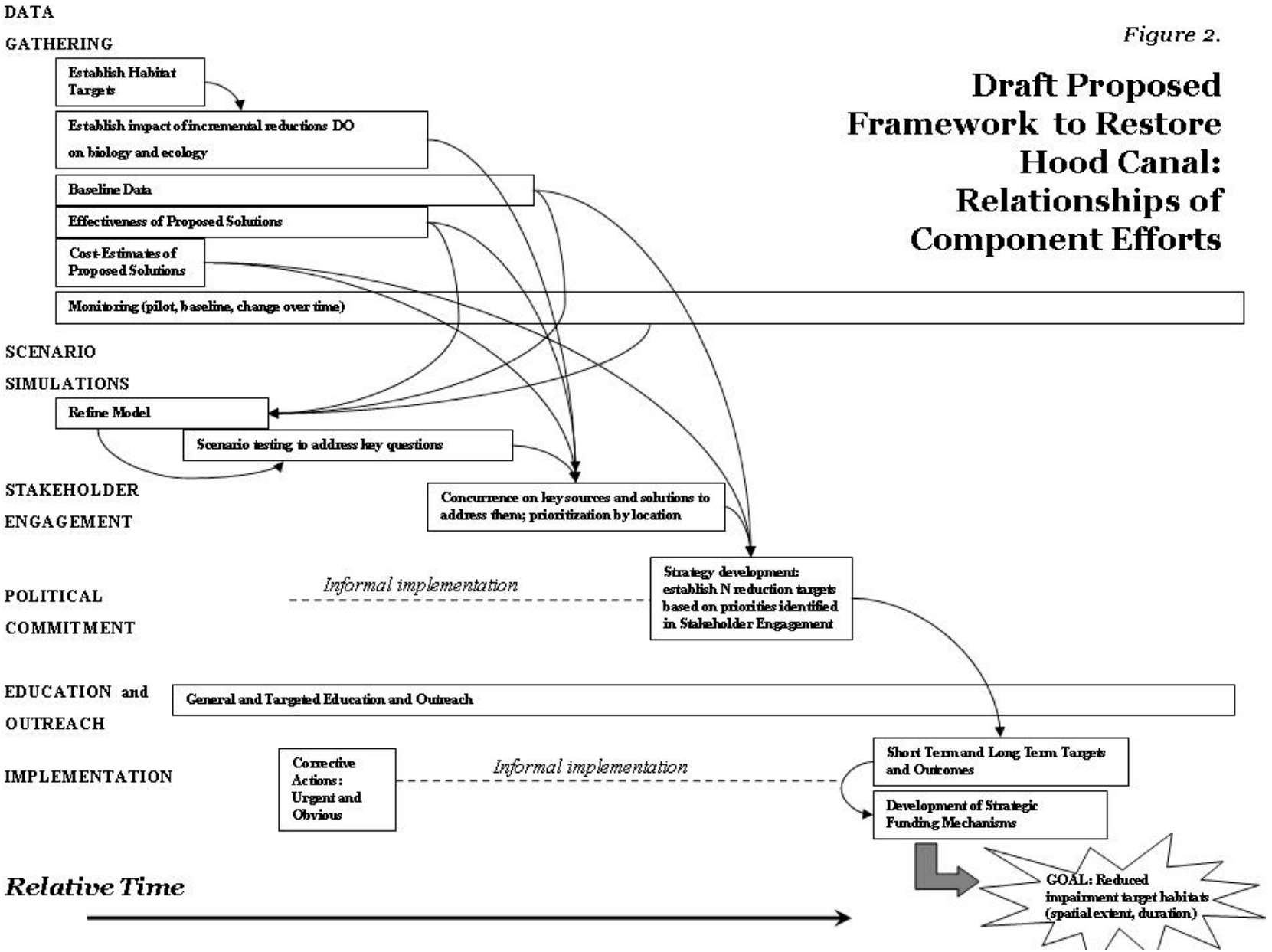


Figure 3. Key components of framework and associated activities supporting each component

	Activity	Product	Client	Comments
Data Gathering (D)	**Establish target habitats and key indicator species**	Document establishing delineation of aquatic ecosystem into logical habitats; identification of key indicator and sensitive spp. & DO thresholds assoc. with most sensitive spp. in each habitat.	SS, SE, EO	Monitoring and modeling must be in line with how the ecosystem is segmented. (See Chesapeake Bay example) Using decreased habitat impairment due to DO as end target has greater ability to engage stakeholders and emotional (economic!) commitment.
	Establish impact of incremental Reductions DO on biology/ecology - Species specific - Food web interactions	Document establishing reduction in survival (or other impairment) associated with each incremental reduction in DO. Also document single species impacts to food web.	SE, EO	Important as means to establish direct linkage of DO to habitat improvement (or impairment) as well as indirect species survival interactions
	Gather baseline data - N contribution by key source (Current AND Future) (Focus on key areas uncertainty) - DO levels assoc with estab. target habitats - Current behavior & attitude	Document refining estimates of N contribution by key sources, supported by empirical evidence and/or literature values and/or modeling. *A primary objective being to clarify key uncertainties (N input from on-sites) Document baseline DO values associated with target habitats (uncertain how far back data is necessary to estab. baseline condition for DO?) Survey results assessing current behavior and attitudes Associated with larger-scaled, behavior-based (land-owner based?) N sources (e.g. on-site, salmon, etc.)	SS, SE, EO, P, I	Some focus on all of these aspects already; however, one key area which will need to be addressed and understood is ***projected future development and growth scenarios***, perhaps based on build-out as allowed by ordinances, or following population growth trends. Important in being able to plan strategically for growth. (e.g. mitigating transport mechanisms, buffers, Purchase of land/buffer areas, wetlands, ordinances, permitting sources, potential role of water quality trading program) * Key area of uncertainty surrounds N input from on-site systems. Until empirical evidence exists implicating on-sites as key (and potentially largest) source, stakeholders will be unwilling to engage in mitigating their impacts via retrofits, upgrades, etc.

	Activity	Product	Client	Comments
	Gage effectiveness of potential solutions to red. N from key sources - Empirical evidence; monitoring pilots - Literature search - Model	Document quantifying range of N reduction potential associated with potential solutions, calibrated to local conditions. Empirical evidence needed for areas of greatest uncertainty (e.g. on-site effectiveness); Literature search/model sufficient for more direct options (e.g carcass removal)	SS, SE	The bulk of the 18 funded pilot projects administered by PSAT are focused within this component.
	Gather cost-estimates for potential Solutions (infrastructure focused)	Document identifying potential alternatives and costs associated with range of alternative solutions (e.g. on-site and/or community treatment alternatives.	SE, PC	May also be important to look at future growth scenarios, and whether it makes sense to upgrade To community systems in high growth areas
	Monitor wq and key species assoc. with target habitats (*CONTINUOUS*) - Baseline conditions target habitat - Support effectiveness of pilots - Change in condition over time	Publish report analyzing monitoring and behavior data to assess trends in baseline condition, effectiveness of pilot projects (testing source contribution of N, effectiveness of N reduction project, etc), current attitudes / behavior, and change of each over time.	SS, SE, EO, I	Ensure that monitoring plan is aligned with targeted habitats
Water Quality Assessment (WQA)	**~~Refine~~ Develop model(s) with data collected under (D)**	**Documented, Tested, and Peer-Reviewed Model and Source Assessments**	SS	
	Run scenario simulations to: - Verify key sources N input to HC - Quantify human N contribution and influence on HC DO - Identify high risk areas - Gage effectiveness of potential solutions in improving DO in target habitats - Translate N reduction to DO improvement in HC	Report summarizing model outputs containing elements such as: - Identification of key sources N input and impact of ***<u>each</u>*** ***<u>source</u>*** on DO; by source ***and*** area - Identification of high risk areas based on suite of criteria found assoc w/ high risk (high N input and strong linkage with DO impairment) e.g. soils, geology, distance to stream, density, areas of low mixing, etc.). *ID both Current ***and Future*** high risk areas to help target efforts - Quantify human influence on DO in HC - Gage effectiveness of potential solutions to Improving DO in target habitats; highlight areas of greatest potential (biggest bang for $) and/or priority areas to focus.	SE, PC EO, I	Model is critical mechanism to translate N reductions to DO improvements. May be be particularly useful to be able to segment watershed in analyses (e.g. by political boundary, areas of high vs. low density, etc.)

	Activity	Product	Client	Comments
Stakeholder Engagement (SE)	**Stakeholder engagement to get broad-scale concurrence on key sources (current and future) solutions to address them.** Series Of meetings to bring together key members Of the public, decision makers, scientists, Etc. to ensure everyone is on board from Initial phases of strategy development. Priority setting should be informed largely From data and information gathered in (D) and (SS). Information to guide process: - N input into HC broken out by - Source - Area - Impact of N on DO by - Source - Area - Impact incremental reductions DO on biology/ecology (potential species/ habitat loss) - Impact to local economy - Unit Response Matrix to aid cost-benefit Analysis of entire range of potential N Reduction solutions. (Rhode Island example) - Costs of incremental red.in N Assoc. w/ dif. Levels mgmt - Resultant improvements DO Assoc. w/ dif. Levels mgmt; by source and area - High risk areas identified by criteria Established in (SS). Current and Future. - Other potential additional means to reduce N input via transport (stormwater) or mitigation (wetlands)	Prioritized list of sources to address and solutions, potentially by location (if particular hot spots exist) developed by stakeholders and informed by data and info gathered in (DG) and (SS).	PC	Akin to wetlands mitigation sequencing guidelines of Avoid, Minimize, Compensate. Here, discussion under 'other potential means' should be treated as an additional bonus, not as primary means to address DO. Focus of discussion should initially focus on source control, then influencing transport mechanisms and Mitigation measures. 1. Source Control (current and future) 2. Minimize transport 3. Mitigate (wetlands) ? Consideration of WQ trading scheme to allow for growth while freezing N inputs to system; funding Mechanism for implementation of BMPs, other proposed solutions?

	Activity	Product	Client	Comments
Political Commitment (P)	**Establish Nitrogen Reduction Targets,** informed by: - Priorities established in stakeholder Engagement process - Commitments by counties for N Reduction goals per watershed Segment (accountable to political and Ecological 'boundaries') - Phased approach - % target achieved / yr - Prioritized areas / high risk areas first - In-basin then out of basin (air, tributary) - Source prioritization (biggest bang for $) - Long-term goal of achieving WQS; Drafting TMDL	Document establishing political commitment of each county (?) for N reduction in each watershed segment (WRIA or smaller scale?). Plan for how targets will be achieved; timeline for meeting phased targets.	EO, I	
Education and Outreach (EO)	**General and Targeted Education and Outreach** to communicate problem, issues and solutions. How-to guide for land-owners, Farmers, planners, utilities, etc.			
Implementation And Strategic Funding (I)	**Implementation of N targets established at county and watershed level.** Ramping up of pilot projects and other solutions identified.	Each implementation activity should have its own logic model detailing Activities involved, expected short and long-term outcomes, and funding Strategy to support implementation.		Identify ***linkages*** to other funding efforts currently underway in EPA (e.g. pathogens and on-site upgrading; SRF, stormwater, NPS, etc. etc.)